A Summary of the Vocabulary Research With Students Who Are Deaf or Hard of Hearing

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Vocabulary is essential for communicating, reading, thinking, and learning. In comparison to typical hearing peers, students who are deaf or hard of hearing demonstrate vocabulary knowledge that is quantitatively reduced. The authors review and summarize research studies published in peer-reviewed journals between 1967 and 2008 focusing on vocabulary and students who are deaf or hard of hearing. Forty-one studies are examined. A summary of each study is presented in a table, and potential educational implications are described. The authors note the paucity of research to guide instruction and provide suggestions for future research.

Vocabulary has been defined as "the storehouse of word meanings that we draw on to comprehend what is said to us, express our thoughts, or interpret what we read" (Moats, 2005, p. 7). The depth and breadth of individuals' vocabulary is highly correlated with their overall language development and is a factor in their ability to use language in varied contexts and for multiple purposes (Montgomery, 2007; Richgels, 2004).

For the past 65 years, it has been an established assumption that a strong correlation between vocabulary knowledge and reading comprehension exists (e.g., Davis, 1944). Words encountered in texts are mapped onto readers' receptive vocabulary. However, when specific words are not in an individual reader's vocabulary, the printed words are not understood and it is challenging for the reader to make sense of the passage. As a result, it is often noted in the literature that reading comprehension is impeded if individuals do not know 90%–95% of the total words in the text (Carver, 1994; Chall, Jacobs, & Baldwin, 1990; Na & Nation, 1985, Nagy & Scott, 2000). Additionally, vocabulary contributes to comprehension because it provides the building blocks for higher-order thinking skills. Individuals who know more words often find it easier to make inferences and to integrate information into coherent thoughts (Sénéchal, Ouellette, & Rodney, 2006).

Several studies have also demonstrated that children's vocabulary knowledge early in school influences their reading comprehension skills later in life. For example, Tabors, Snow, and Dickinson (2001) reported that

receptive vocabulary knowledge in kindergarten was predictive of reading comprehension skills in the 4th and 7th grades. Concomitantly, Cunningham and Stanovich (1997) found that receptive vocabulary in 1st grade had a substantial relationship with reading comprehension in 11th grade.

How Do Children Learn Vocabulary?

Children learn vocabulary indirectly as well as directly (Armbruster, Lehr, & Osborn, 2003). Most vocabulary knowledge is acquired indirectly through daily interactions with adults, siblings, and peers that occur through conversations around routines, games, nursery rhymes, songs, and reading activities (Burns, Griffin, & Snow, 1999; Landry & Smith, 2006). More specifically, children learn words indirectly through conversational exchanges with sophisticated language users who pay close attention to the young child's communication attempts and who respond to the child about an object or activity of interest. Simultaneously, the skilled language user models new vocabulary, expands on the child's utterances, prompts to keep the conversation going, and repairs conversation breakdowns. As a result, as research has consistently demonstrated, a major factor explaining differences in vocabulary size among young children is the quantity and quality of language input to which they have been exposed at home during the first few years of life (Hart & Risley, 1995, 2003; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Rowe & Goldin-Meadow, 2009; Weizman & Snow, 2001; Wells, 1986).

Individuals also learn many new words indirectly once they are able to read independently. Cunningham and Stanovich (1998) estimated that fifth graders who read for 20 minutes each day read almost 2 million more words per year than students who cannot, or do not, read. If 2% of the words are unfamiliar to students, then they will be exposed to 40,000 new words each year (Anderson & Nagy, 1991). Equally important to note is the fact that exposure to new and unfamiliar words occurs significantly more with the use of print media than in conversation or watching television. The exposure rates per 1,000 words are 68 for newspapers, 65 for magazines, 53 for comic books, and 31 for elementary children's books, as compared to exposure rates per 1,000 words of 17 for conversations between friends and 2 for viewing of television shows such as *Sesame Street* (Cunningham & Stanovich, 1998). However, as noted above, individuals need to have strong receptive vocabularies in order to read independently.

Word learning is an incremental process that begins at birth and continues throughout life. Research (e.g., Anglin, 1993; Biemiller, 2005, 2006; Biemiller & Slonim, 2001) suggests that average hearing children acquire the meaning of about 860 root words per year (e.g., *desk*, *sleep*, *cousin*), or about 2.4 root words per day, for a total of approximately 6,000 root words by the end of second grade. This ongoing process of learning root words combines with understanding and using affixes in the lifelong quest to master the estimated 450,000–750,000 words that make up the English language (Stahl, 1999; Tompkins, 2005). Simultaneously, humans' understanding of words goes through a sequence of three stages. As suggested by Armbruster and colleagues (2003), the three stages are:

1. Unknown: The word is completely unfamiliar, and the meaning is unknown.
2. Acquainted: The word is somewhat familiar; the individual has some idea of its basic meaning.
3. Established: The word is very familiar; the individual can immediately recognize its meaning and use the word correctly.

Though most words are learned indirectly, some vocabulary must be taught directly. Direct vocabulary instruction helps students learn high-frequency words that appear most often in texts, as well as difficult words that represent complex concepts that are not part of their everyday experiences. Direct vocabulary instruction also includes teaching students word-learning strategies, such as structural analysis (using morphological clues such as root words and affixes), phonic analysis (using letter/sound correspondence to pronounce unfamiliar written words), using context clues to determine word meanings, and using dictionaries and other reference aids (Armbruster et al., 2003).

Vocabulary demands for reading also change over time. Words become increasingly abstract as students progress through school (Minskoff, 2005). In the early grades, the majority of words that children learn are based on their experiences and refer to concrete concepts (people, places, things). By the third or fourth grade, students are expected to read all the words in their oral vocabularies (M. F. Graves, Juel, & B. B. Graves, 1998). After fourth grade, the words that students are expected to read are abstract (e.g., *linear*, *percentile*, *density*, *inertia*) and come from their textbooks and classroom discussions in their content-area classes (Minskoff, 2005). Finally, acquisition of vocabulary for succeeding in postsecondary education, living independently, and understanding concepts of employability and employment (e.g., *arbitration*,

deductible, *reimbursement*) continues throughout one's life (Fisher, Clark, & Patton, 2004).

Vocabulary Knowledge of Students Who Are Deaf or Hard of Hearing

The literature consistently suggests that the vocabulary knowledge of students who are deaf or hard of hearing is quantitatively reduced as compared to that of typical hearing peers. More specifically, it has frequently been reported that students who are deaf or hard of hearing are delayed in their acquisition of vocabulary knowledge, have smaller lexicons, acquire new words at slower rates, and have a narrower range of contexts that result in word learning (Cole & Flexer, 2007; Easterbrooks & Estes, 2007; Lederberg, 2003; Lederberg & Spencer, 2001; Marschark & Wauters, 2008; Paul, 2009; Rose, McAnally, & Quigley, 2004; Schirmer, 2000; Trezek, Wang, & Paul, 2010).

In consideration of (a) the important role that vocabulary plays in learning to read and becoming a fluent reader (August & Shanahan, 2006; National Reading Panel, 2000), (b) the challenges that students who are deaf or hard of hearing experience in becoming skilled readers (Holden-Pitt & Diaz, 1998; Karchmer & Mitchell, 2003; Qi & Mitchell, 2007; Traxler 2000), and (c) the demand for evidence-based practices to guide instruction (see the No Child Left Behind Act of 2001, Pub. L. 107–110), the purpose of the present study was to examine the research on vocabulary with students who are deaf or hard of hearing. Because there are few examples in deaf education of experimental research addressing teaching practices that have been tested and demonstrated as being effective with this population (see, e.g., Easterbrooks & Stephenson, 2006; Luckner, Sebald, Cooney, Young, & Muir, 2005/2006; Schirmer, & McGough, 2005), we followed the recommendations of Valentine and Cooper (2004) and conducted a syntheses of the research summarizing the evidence, and created a summary that could be used by practitioners, researchers, and administrators in the field of deaf education.

Method

A two-step literature search strategy was used to identify pertinent studies. First, we conducted computer searches in Sage, PsychINFO, Ebsco Host, ComDisDome-CSA, Wilson Web-Education Full Text, Google Scholar, and the website that allows for searches in the journals of the American Speech-Language-Hearing Association (ASHA). We used the literature search terms *deaf*, *deafness*, *hard of hearing*, *hearing impaired*, *hearing impairment*, *vocabulary*, and *semantics*. Specifically, the terms *deaf*, *deafness*, *hard of hearing*, *hearing impaired*, and *hearing impairment* were individually cross-referenced with *vocabulary* and *semantics*. Second, the reference list of every identified study was reviewed, and any studies on vocabulary that were listed were retrieved and reviewed. We did not include other sources of the literature (e.g., Dissertation Abstracts International, book chapters), conference presentations, or unpublished studies. To be included in our analysis, a study had to meet four criteria:

1. It was published in a peer-reviewed journal between 1967 and 2008.
2. Participants were identified as students who were deaf or hard of hearing.
3. It addressed vocabulary.
4. The sample consisted of children and youth between 3 and 21 years of age.

Results

Table 1 provides a summary of the 41 studies we reviewed. The table was developed following the format used by Luckner and Handley (2008). Specific information entered into the table for each study included the author(s) and year of the publication, control group information, type of study (i.e., designs described by Campbell & Stanley, 1963; M. D. Gall, J. P. Gall, & Borg, 2003; Huck, 2008), age range, gender and ethnicity of the participants, setting, communication modality, degree of hearing loss, intervention and duration, dependent variable, summary, and implications of the study. A full citation of each study is presented in Appendix A, titled, "Studies Reviewed Reference List," in standard American Psychological Association bibliographic format.

The majority of the studies (76%, $n = 31$) did not have an intervention. Only 10 studies (24%) were conducted to examine the effect a specific program, method, approach, or set of activities had on the vocabulary learning of a specific sample of students who were deaf or hard of hearing. Additional inspection of the types of studies conducted indicates that many were descriptive (34%, $n = 14$): The researchers collected data in order to answer a specific research question or hypothesis about a specific sample of students. Thirty-seven percent of the studies ($n = 15$) were causal-comparative: The researchers compared the outcome or performance of at least two sample groups regarding aspects of vocabulary knowledge or learning. Five (12%) of the studies were one-shot case studies, and 2 (5%) were pretest/posttest one-group design re-

search studies. Also undertaken were 1 (2%) posttest-only control group study; 1 (2%) correlational study; 1 (2%) single-subject case study; 1 (2%) pretest/posttest, retest design study; and 1 (2%) within-student multiple baseline study.

Inspection of the intervention studies indicates that only two interventions had positive outcomes in more than a single study. Those interventions and the specific type of research designs used were (a) utilizing a computerized program to explicitly teach vocabulary words (1 pretest/posttest retest study, 1 within-student multiple baseline study), and (b) utilizing aural/ oral habilitation in order to enhance vocabulary skills following cochlear implantation (1 descriptive study, 1 single-subject case study). Five interventions demonstrated positive effects in a single study. Those interventions and the specific type of research design used were

1. using Total Communication methods to improve vocabulary (1 descriptive study),
2. integrating words into an intensive daily vocabulary program (1 pretest/posttest one-group design study)
3. providing early intervention after identification of a hearing loss (1 descriptive study)
4. using a tactile device to enhance word learning (1 descriptive study)

In the fifth study, the researchers did not provide a description of the intervention (1 one-group pretest/posttest design study).

Following is a summary of the studies presented in Table 1 in which similar themes were identified in more than a single study:

1. In 6 studies (4 descriptive studies, 1 single-subject case study, 1 causal-comparative study), the researchers stated that earlier age of cochlear implantation had a positive effect on vocabulary acquisition and development.
2. In 4 studies (3 descriptive studies, 1 one-group pretest/posttest design study), the researchers reported a positive relationship between vocabulary and reading comprehension.
3. In 4 studies (2 descriptive studies, 1 single-subject case study, 1 causal-comparative study), the researchers reported that cochlear implants improved vocabulary performance.
4. In 4 studies (all causal-comparative studies), the researchers noted that hearing students performed significantly better than students with a hearing loss on vocabulary tasks.
5. In 4 studies (3 descriptive studies, 1 single-subject case study), the researchers indicated that the MacArthur-Bates Communicative Development Inventories (CDI) was a valid measure for assessing vocabulary skills.
6. In 3 studies (2 descriptive studies, 1 posttest-only control group study), the researchers discussed the positive impact of Total Communication on vocabulary acquisition and development.
7. In 2 studies (both causal-comparative studies), the researchers recommended teaching semantic organization and semantic concepts.
8. In 2 studies (both causal-comparative studies), the researchers recommended teaching frequently used English words.
9. In 2 studies (both one-group pretest/posttest design studies), the researchers recommended the use of intensive vocabulary instruction.
10. In 2 studies (both one-shot case studies), the researchers suggested instruction in inferential strategies to assist vocabulary development.
11. In 2 studies (both one-shot case studies), the researchers recommended the introduction of key words using rich and explicit examples.
12. In 2 studies (both descriptive studies), the researchers suggested teaching of novel words to assist vocabulary acquisition.
13. In 2 studies (both descriptive studies), the researchers discussed the importance of a minimum vocabulary in order to use word-learning strategies.
14. In 2 studies (1 causal-comparative study, 1 descriptive study), the researchers noted that working memory affects vocabulary development.
15. In 2 studies (1 causal-comparative study, 1 descriptive study), the researchers discussed how current level of vocabulary knowledge affects novel word-learning skills.

Discussion

People use the words in their vocabulary to think, to express ideas and feelings, and to learn about the world. Simultaneously, as Montgomery (2007) has noted, "vocabulary knowledge is among the preeminent predictors of success in learning to read" (p. 1). Because words play such an essential role in learning to read as well as learning academic subjects, improving students' vocabulary knowledge has become an educational priority. In

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Table 1
Summary of the Characteristics of the Reviewed Studies

Source	*Control group*	*Type of study*	*Age (years–months)*	*Participants/ gender*	*Ethnicity (where conducted)*	*Setting*	*Communication modality*
Cooper, 1967	No	Causal-comparative	Deaf = 7.2–19.9; Hearing = 7.2–18.1	Deaf = 140–111 female/29 male; Hearing = 176–142 female/34 male	Not reported/ New York City	School for deaf students/ Neighboring parochial school	Not reported
Griswold & Commings, 1974	No	Descriptive	1.9–4.6	19 /Not reported	Not reported/ Maryland	Maryland School for the Deaf (MSD)	Total Communication
Tweney, Hoemann, & Andrews, 1975—Study 1	No	Causal-comparative	Deaf = 16–18, Hearing = 16–18	Deaf = 63, Hearing = 63	Not reported/ Kentucky	Deaf = residential school for students who are deaf, Hearing = public high school	American Sign Language and spoken English
Tweney, Hoemann, & Andrews, 1975—Study 2	No	Causal-comparative	Deaf = 16–18, Hearing = 14–17	Deaf = 63, Hearing = 63	Not reported/ Kentucky	Deaf = residential school for students who are deaf, Hearing = public high school	American Sign Language and spoken English
Walter, 1978	No	Causal-comparative	14—Oct	Deaf = 199, Hearing = 277/not reported	Not reported/ Hearing—Detroit; Deaf—across United States	Elementary school	Not reported
Brenza, Kricos, & Lasky, 1981	No	Descriptive	13.0–14.0	15/Not reported	Not reported	Mainstream school setting	Oral

Degree of hearing loss	*Intervention and duration*	*Dependent variable*	*Summary*	*Implications*
133 = profound, 7 = severe	No intervention	A 48-item test of morphological rules	The researcher compared students who were deaf and students who were hearing on their knowledge of morphological rules, specifically inflectional and derivational suffixes. Hearing students performed significantly better than deaf students. The oldest group of deaf students did not perform as well as the youngest group of hearing students. The scores on the morphology test were highly correlated with reading and vocabulary test scores for both deaf and hearing participants.	Students who are deaf may benefit from instruction in the rules of English morphology.
Not reported	No intervention	Mothers kept track of known and newly acquired vocabulary words in individual notebooks throughout the preschool program.	The researchers compiled a list of 493 different words used in the children's expressive vocabulary. Of the 493 words, 33% were used by one child. Length of time in the preschool program and use of Total Communication at home appeared to be related to vocabulary development.	Total Communication used in an educational program and at home may have a positive impact on vocabulary development.
Severe–profound = 63	No intervention	Index cards with 30 sound words (e.g., *bang, meow*), 30 common noun words (e.g., *kite, car*), and 30 ink drawings corresponding to the list of noun words. Participants were asked to sort the words into categories of similar meaning, using as many or as few categories as desired.	The deaf and hearing students performed similarly on the noun words and the picture words and greatly differed on the sound words.	Students who are deaf use semantic organization processes similar to those of hearing students, except for differences in experiences with sound words.
Severe–profound = 63	No intervention	Index cards with 30 noun words, 19 high-imagery words (e.g., *circle, magazine*), 19 low-imagery words (e.g., idea, hope). Participants were asked to sort the words into categories of similar meaning, using as many or as few categories as desired.	The deaf and hearing students performed similarly in sorting the high-imagery, low-imagery, and noun words.	Students who are deaf can organize high-imagery words, as well as low-imagery words, as well as their hearing peers.
Profound	No intervention	Frequency-Based Test of Vocabulary	The researcher compared students who were deaf and students who were hearing on their knowledge of frequently used English words. Hearing students performed significantly better than students with a hearing loss. The oldest group of deaf students did not perform as well as the youngest hearing students.	Most of the students who were deaf were not knowledgeable of many of the most frequently used English words. Educators should not overestimate students' vocabulary knowledge and should integrate lexical instruction into the language program.
Profound = 14, Moderate = 1	No intervention	The Boehm Test of Basic Concepts (BTBC) was administered to determine word	Eighty percent of the children with hearing loss scored below the 10th percentile. Sixty-seven percent of the	Children with a hearing loss may demonstrate difficulties with semantic concepts, which

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Table 1 ***(continued)***

Source	*Control group*	*Type of study*	*Age (years–months)*	*Participants/ gender*	*Ethnicity (where conducted)*	*Setting*	*Communication modality*
Robbins & Hatcher, 1981	Yes	Posttest-only control group	9–12, *M* = 10.7	36—Not reported	Not reported/Iowa	Residential school for deaf students	Total Communication
Howell, 1984	No	Descriptive	3.7-4.1	4: 2 males/ 2 females Two participants had hearing parents, and two had deaf parents.	Not reported/ Maryland	School and home settings	Total Communication
Brooks, Frost, Mason, & Gibson, 1987	No	Descriptive	18	2/female	Not reported/ Canada	Not reported	Participant 1 = fingerspelling and sign language Participant 2 = moderately oral
LaSasso & Davey, 1987	No	Descriptive	10–18, *M* = 15.9	50—not reported	Not reported	Residential school for deaf students	Not reported
Strassman, Kretschmer, & Bilsky, 1987—Study 1	No	One-shot case study	13.4–20.2, *M* = 17.6	22: 14 female/ 8 male	Not reported/ New Jersey	Public school	Total Communication

Degree of hearing loss	*Intervention and duration*	*Dependent variable*	*Summary*	*Implications*
		meanings. Fifty concepts were presented. Participants were also asked to use the words in sentences. A total of 750 sentences were analyzed.	children scored at or below the 1st percentile. The researchers also noted that 4% of the sentences contained semantic errors, and 35% contained semantic and syntactic errors.	may hinder their academic performance. Teaching basic semantic concepts may be beneficial. The BTBC may be a useful assessment instrument.
Severe-profound = 36	Half of the students were trained to recognize and comprehend the words used in the study by using flash cards and being given signs for the words, shown pictures of the objects, and encouraged to discuss the words and pictures in conversation. The other half were not taught the words.	Twenty-seven sentences of varied syntactic form and difficulty using the target vocabulary. Each sentence was presented along with four pictures. Students were asked to pick the picture that best represented the meaning of the test sentence.	There was no difference in sentence comprehension between the group of students who were trained in the vocabulary words and those students who received no training on the vocabulary words.	Training students on vocabulary words in isolation does not appear to have a positive effect. Instead, the authors suggest that it is more appropriate to teach vocabulary words in context. Also, difficulty with syntactic forms hinders students' reading comprehension. Syntactic knowledge should be a component of reading instruction.
Severe = 1, Profound = 2, Not reported = 1	Total Communication class three times a week to focus on vocabulary words. Participants' mothers recorded their child's vocabulary growth.	MSD preschool vocabulary list with 1,655 words. The mothers reported information to teachers during school and home visits.	The children who participated in early intervention programs with their families showed significant improvement in vocabulary skills. Total Communication was beneficial to all four children in developing vocabulary.	Total Communication may be an effective way to improve vocabulary development regardless of whether parents are deaf or hearing.
Profound = 2	Thirty-minute training sessions using the Queens University tactile vocoder, a device that allows the acoustic wave form to be felt as a vibrational pattern on the skin. Once a day, 4 days per week, over a period of 3 months. Stimulus word tests followed 20 minutes of training.	A list of 50 stimulus words. Initially, each participant was tested on a list of 3 words within 50 random presentations. Each word was presented twice, and the researcher gave immediate feedback. More words were added to the list of presentations once the participant achieved a score of 80% accuracy.	Both students reached a criterion of 80% accuracy on the list of 50 stimulus words. Student 1 achieved the score within 28.5 hours, and student 2 accomplished 80% within 24.0 hours.	Word learning may be enhanced by using a tactile vocoder.
Profound = 50	No intervention	Vocabulary Comprehension Subtest of the Gates-MacGinitie Reading Tests; Reading Comprehension Subtest of the Stanford Achievement Test (SAT); Cloze Reading Tasks; multiple-choice tasks for reading passages; free-response tasks for reading passages.	Regardless of specific reading comprehension task used, vocabulary scores were highly predictive of reading comprehension performance.	Vocabulary knowledge is highly correlated with reading comprehension performance.
Severe-profound	No intervention	Thirty-six pairs of sentences with each pair containing a target sentence and a control sentence that required students to	Students were asked to make inferences about a particular noun when general categorical information was provided (e.g., "The man flew the	Students made inferences when prompted to do so, rather than spontaneously. Students who are deaf may

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Table 1 *(continued)*

Source	*Control group*	*Type of study*	*Age (years–months)*	*Participants/ gender*	*Ethnicity (where conducted)*	*Setting*	*Communication modality*
Strassman, Kretschmer, & Bilsky, 1987—Study 2	No	One-shot case study	13.4–20.2, *M* = 17.6	21: 13 female/ 8 male	Not reported/ New Jersey	Public school	Total Communication
Conway, 1990	No	Causal-comparative	6.0-11.0	56—Not reported 28—younger than 9.0 28—older than 9.0	Not reported/ Nebraska	Residential school for deaf students and in the public school setting	Not reported
Paul & Gustafson, 1991	No	Causal-comparative	Deaf = 10.7–18.11, *M* = 14.7; Hearing = 8.11–10.11, Mean = 9.6	Deaf= 21 male/21 female Hearing = 21 male/21 female	Not reported	Deaf = residential school for students who are deaf, Hearing = Public elementary school	Simultaneous Communication
de Villiers & Pomerantz, 1992—Study 1	No	One-shot case study	12.10–18.7, *M* = 15.11	30/ Not reported	Not reported	Oral school for deaf students	Oral
de Villiers & Pomerantz, 1992—Study 2	No	One-shot case study	Oral—9.2–14.8, *M* = 12.6,	36/ Not reported	Not reported	21 = oral school for deaf students, 15 Total Communi-	21 = oral, 15 = signed English

Degree of hearing loss	*Intervention and duration*	*Dependent variable*	*Summary*	*Implications*
		infer what the noun phrase was referring to (e.g., "The ship moved underneath the water" referred to a submarine).	plane," students needed to indicate that the man was a pilot). Students were successful about 70% of the time.	benefit from instruction and practice inferring word meanings from context.
Severe-profound	No intervention	Ten sets of three sentences that included either a control, a target, or an exemplar sentence were shown to students for a period of 12 seconds. Then students were given a cued recall test and instructed to read the word and write the sentence it made them think of.	Students demonstrated a poor rate of recall, only recalling about 27% of the cues. They recalled exemplar sentences (e.g., "The bee stung the girl") better than sentences that required them to infer.	Students who are deaf or hard of hearing may benefit from increased attention to semantic representations and inference strategy instruction.
Profound = 56	No intervention	Students were asked to tell the examiner everything they knew about 10 common nouns with picture representations. The examiner used open-ended prompts(e.g., "Can you tell me more about ___") to determine how much the students knew about the objects.	All students were able to identify the common nouns. Open-ended prompts helped students produce more responses. The older group gave more responses, yet the type and complexity of the responses were no different than those of the younger group. In addition, both groups of students with a hearing loss produced responses that were at a level similar to that of younger hearing students.	The use of open-ended prompts that promote the understanding of semantic relationships may lead to multiple responses and to richer word descriptions.
Profound = 42	No intervention	A 60-item picture vocabulary test to assess comprehension of one or two meanings of high-frequency multimeaning words.	Hearing students performed significantly better than deaf students. For both the deaf and the hearing groups there was a correlation between students' ability to select two meanings of multimeaning words and their reading vocabulary and reading comprehension levels.	Vocabulary instruction should include attention to frequently used multimeaning words (e.g., *bat, call, change, sink*).
Profound = 26, Severe = 4	No intervention	A test booklet was developed that assessed students' semantic knowledge and grammatical knowledge of six nouns, six verbs, and six adjectives. For each word, three contexts were created that varied in how informative they were of the unknown word—a lean context , a rich context and an explicit context.	Students performed significantly better using the rich context (e.g., "The old house on the hill was an eerie place. It was dark and it had broken windows, and it looked like ghosts lived in it") and explicit context (e.g., "In the daytime the woods look safe and friendly, but at night they can be an eerie place. The trees look strange and scary in the dark"), in contrast to the lean context (e.g., "The boy painted a picture of an eerie house in his art class. He took it home to show his mother and father"). There was no difference between the rich and the explicit contexts. Reading comprehension skills had a significant impact on students' ability to determine word meanings using context.	Vocabulary instruction may be more effective when educators introduce key words using meaningful passages with rich and explicit examples. Students may benefit from being taught strategies for learning vocabulary from context.
Profound = 31 Severe = 5	No intervention	A test booklet was developed that assessed students' semantic knowledge and	Students performed significantly better using the rich and explicit contexts in contrast to the lean context. There was	Same as Study 1.

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Table 1 *(continued)*

Source	Control group	Type of study	Age (years–months)	Participants/ gender	Ethnicity (where conducted)	Setting	Communication modality
			Total Communication = 10.11–15.4, *M* = 13.2			cation school for deaf students	
Kidd, Madsen, & Lamb, 1993	No	One-shot case study	Not reported, grades 9–12	25/Not reported	Not reported	Residential school for deaf students	Total Communication
Dawson, Blamey, Dettman, Barker, & Clark, 1995	No	Descriptive	Not reported/ age at implantation = 2.6–19.9	32–16 males/ 16 females	Not reported/ Australia	Not reported	Oral
Gilbertson & Kamhi, 1995	No	Causal-comparative	Normal hearing = 5.1–9.7 Hearing loss = 7.9–10.7	40–16 male/ 24 female	18—African American 22—Not reported	Not reported	Oral
Kelly, 1996	No	Correlational	Not reported	213—108 male/ 105 female	Not reported	Not reported	Oral communication and Total Communication

Degree of hearing loss	*Intervention and duration*	*Dependent variable*	*Summary*	*Implications*
		grammatical knowledge of six nouns, six verbs, and six adjectives. For each word, three contexts were created that varied in how informative they were about the unknown word—a lean context, a rich context and an explicit context.	no difference between the rich and explicit contexts. Middle school students did not perform as well as the upper school students reported in Study 1. No significant differences existed between students who used oral English or Signed English. Reading comprehension skills had a significant impact on students' ability to determine word meanings using context.	
Not reported	No intervention	Fifty-item multiple-choice test focusing on seventh- and eighth-grade mathematics vocabulary (e.g., square, multiplier, sine, how many more).	Even though students were enrolled in high school level (grades 9-12) mathematics classes, the mean percentage of seventh- and eighth-grade mathematics words identified correctly was 46%.	The authors suggest that weaknesses in mathematical vocabulary may cause students to not understand what they read about in mathematics. More emphasis on mathematical vocabulary is recommended. The authors suggest that mathematics terms should be introduced by teaching the written word and the symbol, providing examples, and involving students in conceptually based activities.
Profound	One and a half (1.5) hours of individual speech and language habilitation were provided at regular intervals, in addition to the standard educational services provided before the preoperative period and after the postoperative period.	Peabody Picture Vocabulary Test-III (PPVT-III). Skills were assessed before implantation, at 6 months after implantation, 36 months after implantation, and 42 months after implantation.	The mean performance of postoperative scores on the assessment was significantly higher than the mean preoperative performance scores. All of the participants showed vocabulary scores below expected chronological ages; however, the postoperative scores indicated an increased rate of vocabulary acquisition and improvement over time.	Vocabulary acquisition and performance may improve after cochlear implantation and speech and language habilitation.
Normal hearing = 20 Mild to moderate = 20	No intervention	Lexical acquisition and retention tasks: Series of four novel words (e.g., tam, jaften) were taught in random order as part of a four-stage word-learning paradigm: (1) exposure (2) comprehension (3) production (4) recognition	Ten children with a hearing loss performed just as well as the children with normal hearing. The other 10 children with a hearing loss performed at a lower level on novel-word learning tasks than the 10 children with a hearing loss who were seen as higher-functioning children. The students who performed best on the novel-word learning tasks also performed well on the PPVT-R and on two phonological processing tasks.	The degree of hearing loss may not be a predictor of vocabulary development.
Not reported	No intervention	Reading Vocabulary subtest of the California Achievement Test, the Test of Syntactic Abilities, Reading Comprehension subtest of the Stanford	Vocabulary knowledge and syntax knowledge were each highly correlated with reading comprehension.	Vocabulary knowledge is positively influenced by syntactic knowledge, which in turn influences reading comprehension. The development of syntactic

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Table 1 ***(continued)***

Source	Control group	Type of study	Age (years–months)	Participants/ gender	Ethnicity (where conducted)	Setting	Communication modality
Willis & Edwards, 1996	No	Single-subject case study	4.3	1—female	Not reported	Not reported	Oral
Connor, Hieber, Arts, & Zwolan, 2000	No	Causal-comparative	Not reported	147—71 males/76 females Participants were divided into 3 groups based on the age of cochlear implantation: 1) before 5.0 2) 5.0–6.9 3) 7–10.0	Not reported/ Michigan, Ohio, and Indiana	A variety of settings including self-contained, mainstreamed, inclusive, and home school.	Oral communication (OC) Total Communication (TC)
Lederberg, Prezbindowski, & Spencer, 2000—Study 1	No	Descriptive	3.2–6.10, *M* = 5.1	19—11 female/ 8 male	12 Caucasian, 4 Hispanic, 3 African American	State day school for deaf/hard of hearing students	ASL signs in English word order
Lederberg, Prezbindowski, & Spencer, 2000 - Study 2	No	Descriptive	Not reported—subset of group from Study 1	7—4 female/3 male	Not reported	State day school for deaf/hard of hearing students	ASL signs in English word order
Moeller, 2000	No	Descriptive	5	112—58 males/ 54 females	Not reported/ Nebraska	Center for Childhood Deafness	51 = Total Communication

Degree of hearing loss	*Intervention and duration*	*Dependent variable*	*Summary*	*Implications*
		Achievement Test—Hearing Impaired Edition		competence should be addressed in reading programs for students who are deaf or hard of hearing.
Profound	The participant received 20 sessions of oral/aural habilitation at 1.0-1.5 hours per session. The sessions took place over 1 year post-cochlear implantation at 3.3 yrs. The sessions focused on spoken language in meaningful situations.	MacArthur-Bates Communicative Development Inventories (CDI), including the following portions: Words and Gestures, and Words and Sentences. The British Picture Vocabulary Scale (BPVS) was also administered.	The scores obtained on the CDI indicated growth in expressive and receptive vocabulary skills. However, the child did not show progress in receptive vocabulary on the BPVS.	Intensive oral/aural habilitation may lead to increased receptive and expressive vocabulary following cochlear implantation.
Severe-profound	No intervention	The Peabody Picture Vocabulary Test-Revised/III was used to measure receptive vocabulary skills, and the Woodcock Johnson Tests of Cognitive Ability was used to evaluate expressive vocabulary ability.	The researchers compared the performance of the TC and OC groups. The groups were matched according to the age of implantation. All of the children (TC and OC) who received cochlear implants prior to age 5 years or during their preschool years achieved better vocabulary outcomes over time than children who received their implants during their elementary school years.	Children may benefit from using cochlear implants regardless of the communication strategy or teaching approach used. Age of implantation may be the most important factor.
Profound = 7 Severe = 8 Moderate to Severe = 4	No intervention	Novel words, MacArthur Communication Development Inventory (CDI)—words and sentences version, Grammatical Analysis of Elicited Language-Pre-Sentence Level (GAEL-P).	Children demonstrated three different levels of word learning. Some learned words quickly in novel mapping and explicit reference contexts; others demonstrated rapid word learning only when reference was explicitly established by an adult; others were not capable of word learning in either context. Also, word-learning abilities were related to children's vocabulary. The teacher-completed CDI was a valid measure of children's vocabulary development.	Children's ability to learn words in novel mapping and explicit reference contexts is related to their vocabulary development. Children need a minimum of approximately 200 words before being able to apply the strategies. Use of word-learning strategies are based on children's repeated experiences with the exposure to novel words used in their environment.
Not reported	No intervention	Same as Study 1	Children who did not pass the novel mapping or rapid word learning assessments in Study 1 were retested over an 18-month period to see when they acquired the skills. All children eventually passed the novel-word learning and rapid word learning assessments. The acquisition of these skills was related to their rate of vocabulary development.	Same as Study 1
9 = Mild 17 = Mild to moderate	All of the children participated in the Diagnostic Early	Peabody Picture Vocabulary Test-III (PPVT-III)	The children who were enrolled in the early intervention program prior to 11 months of age demonstrated stronger	The child's age at the time of enrollment in an early intervention program and the level of

(Continued at the top of p. 53)

Table 1 ***(continued)***

Source	*Control group*	*Type of study*	*Age (years–months)*	*Participants/ gender*	*Ethnicity (where conducted)*	*Setting*	*Communication modality*
							61 = oral communication
Barker, 2003	No	Pretest, posttest, retest	8–14, *M* = 11.1	19 - 9 male/10 female	Not reported/ Oregon	Day school for deaf students	Oral
Connor & Zwolan, 2004	No	Descriptive	Not reported *M* = 11	91—45 male/ 46 female	86=Caucasian, 2=African American, 3=Other ethnicities/ Michigan	Medical center and public school	43 = Total Communication 48 = oral communication
Fagan, Pisoni, Horn, & Dillon, 2007	No	Descriptive	6–14, *M* = 9.1	26—16 male/ 10 female	Not reported	Mainstream school setting	Spoken English
Hansson, Forsberg, Lofqvist, Maki-Torkko, & Sahlen, 2004	No	Causal-comparative	Deaf/Hard of Hearing (DHH) =	DHH = 18 / not reported SLI = 21/not reported	Not reported/ Sweden	University clinic and school for deaf students	Oral

Degree of hearing loss	*Intervention and duration*	*Dependent variable*	*Summary*	*Implications*
19 = Moderate 20 = Severe 47 = Profound	Intervention Program (DEIP) for at least 6 months after being identified with a hearing loss. The intervention included 1–2 weekly home visits and a parent support group.		vocabulary skills at 5 years of age than children who began early intervention after 11 months of age. Family involvement made a positive impact on the child's vocabulary skills.	family involvement may positively affect the vocabulary development of children with a hearing loss. Early intervention programs may be effective in promoting vocabulary development when children and their families are enrolled at younger ages (i.e., before the child reaches age 11 months) and when families are involved.
Profound = 16, Hearing = 3	Vocabulary tutor displaying line drawings or photographs of words (nouns), while a computer-generated avatar provided synthesized audiovisual speech printed words corresponding to the images were presented to students. Younger students = 2.5 hours total; older students = 3.5 hours total.	Identification of words included in the training lessons.	Students could correctly identify significantly more words at the end of each lesson than they could identify at the beginning of the lesson. Most of the students retained more than half of the new words they were taught when retested 4 weeks after the intervention.	The vocabulary tutor may be a useful way to help students identify basic nouns.
Profound	No intervention	Preimplant measures = Picture Vocabulary Test of the Woodcock-Johnson Test of Cognitive Ability and the Expressive One-Word Picture Vocabulary Test. Post-implant measures = Picture Vocabulary Test of the Woodcock-Johnson Test of Cognitive Ability.	Preimplant and postimplant vocabulary skills affected reading comprehension scores. Children who were younger at the time of implantation tended to display higher postimplant vocabulary scores. The children who used Total Communication prior to receiving a cochlear implant showed stronger vocabulary skills after receiving the implant, when their scores were compared to the scores of the children who used oral communication.	Children who use Total Communication and receive a cochlear implant at an earlier age may have stronger vocabulary skills than children who use oral communication and who get a cochlear implant at a later age.
Profound = 26	No intervention	Peabody Picture Vocabulary Test-III (PPVT-III)	A comparison of the scores on the PPVT-III for the participants was below the standard score for hearing children. Greater than half of the participants scored more than one standard deviation below the mean for hearing children. PPVT- III scores were highly correlated with reading test scores. Children who were implanted before a mean age of 2.5 years scored significantly better on both the vocabulary and reading tests compared to participants who were implanted after 2.5 years of age.	Vocabulary and reading comprehension are highly correlated. Students who were implanted prior to the age of 2.5 years performed significantly better on tests of vocabulary and reading comprehension than students implanted after 2.5 years of age.
Mild = 13 Moderate = 5	No intervention	Novel nouns	Children with hearing loss performed better than children with SLI on a novel-word learning task.	Working memory skills should be assessed and included when novel words are being taught.

Table 1 *(continued)*

Source	Control group	Type of study	Age (years–months)	Participants/ gender	Ethnicity (where conducted)	Setting	Communication modality
			9.1–13.3 Specific Language Impaired (SLI) = 8.6–11.4				
Massaro & Light, 2004	No	Within-student multiple baseline	6.11–11.0	8—2 male/6 female	Not reported/ California	Day school for deaf students	Oral
Stelmachowicz, Pittman, Hoover, & Lewis, 2004	No	Causal - comparative	Deaf/Hard of Hearing 6. 9–9.11, *M* = 7. 7, Hearing = 6.3 -9.10, *M* = 7.9	Deaf/Hard of Hearing = 11—5 female/6 male, Hearing = 20—10 female/10 male	Not reported	Not reported	Oral
Singleton, Morgan, DiGello, Wiles, & Rivers, 2004	No	Causal-comparative	Deaf = grades 1–6, Hearing = grades 1–5, ESL = grades 1–5	Deaf = 72/not reported, Hearing = 61/not reported, ESL = 60/not reported	Not reported	Residential school for deaf students, self-contained classrooms, public elementary school	American Sign Language and spoken English
Willstedt-Svensson, Lofqvist, Almqvist, & Sahlen, 2004	No	Descriptive	5.4–11.5 *M* = 7.7	15/ 9 girls, 6 boys	Swedish/Sweden	Lund University Hospital	6 = sign language 4 = oral language 5 = sign and oral language

Degree of hearing loss	*Intervention and duration*	*Dependent variable*	*Summary*	*Implications*
Profound = 2 Severe = 3 Moderately severe = 1 Moderate = 1 Mild = 1	Language Wizard/ Player with Baldi, a computer-animated tutor for teaching vocabulary/20-30 minutes a day, 2 days a week, for 10 weeks.	Set of vocabulary words.	Every student demonstrated significantly positive gains in both identification and production of words introduced.	The Language Wizard/ Player with Baldi may be an efficient program of direct instruction of categories of vocabulary.
Mild = 1, Moderate = 4, Moderately severe = 5, Severe = 1	No intervention	Peabody Picture Vocabulary Test-III (PPVT-III), 40 trials of 5 repetitions of 8 novel words presented in a four-alternative forced-choice format.	Participants viewed a 4-minute animated slide show containing eight novel words. The slide show was narrated by an adult male. Half of the words were presented at 50dB SPL, and the other half were presented at 60dB SPL. Half of the novel words were nouns and half were verbs. Hearing students performed significantly better than the students with a hearing loss, retaining almost twice as many words. PPVT scores were highly predictive of novel-word learning scores.	A student's ability to learn new words is influenced by the amount of words that the student currently knows and by the amount of exposures to the word that the student experiences.
Not reported	No intervention	American Sign Language Proficiency Assessment, total words, frequent words, unique words, and function words written.	The deaf students were divided into 3 groups—low, moderate, and high ASL proficiency. Two additional groups—one hearing monolingual and one hearing ESL group—were included for comparison purposes. Participants watched a 3-minute silent video of "The Tortoise and the Hare" and were asked to retell the story in written English. The three deaf groups wrote fewer words than the two hearing groups. The high- and moderate-proficiency ASL groups used the same percentage of frequently used words and unique words as the monolingual hearing group and performed better on both measures than the ESL group or the low ASL group. The monolingual hearing and ESL groups used significantly more function words (e.g., an, the, at, from) than all three ASL groups.	The moderate and high ASL groups used more diverse vocabulary than the low ASL group and the ESL group. Yet they produced shorter stories and used less function words than either hearing group. The authors suggest that ASL proficiency may offer an entry point into the learning and use of English vocabulary. Instruction in English function words should be addressed.
Not reported	No intervention	Verbal complex working memory tasks, and novel-word learning test in 5 parts: exposure, comprehension, production, recognition, and retention.	The researchers found that the age of cochlear implantation correlated with performance on the novel-word learning tests. Complex working-memory tasks also correlated with novel-word	Age of cochlear implantation may affect novel-word learning ability. Limitations in working memory may also affect novel-word learning skills;

(Continued at the top of p. 57)

Table 1 ***(continued)***

Source	Control group	Type of study	Age (years–months)	Participants/ gender	Ethnicity (where conducted)	Setting	Communication modality
Pittman, Lewis, Hoover, & Stelmachowicz, 2005	No	Causal-comparative	Deaf/Hard of Hearing = 5–14, *M* = 9.4, Hearing = 5–13, *M* = 9.3	Deaf/Hard of Hearing = 37/not reported, Hearing = 60/not reported	Not reported	Not reported	Oral
Connor, Craig, Raudenbush, Heavner, & Zwolan, 2006	No	Descriptive	Not reported	100—not reported/ 21=Group A1 (1–2.5 yrs at Cochlear Implantation (CI)) 15=Group A2 (2.6–3.5 yrs at CI) 20=Group B (3.6-7 yrs at CI) 44=Group C (7.1–10 yrs at CI)	Not reported	Not reported	Oral
Thal, DesJardin, & Eisenberg, 2007	No	Descriptive	32 months–86 months. *M* = 56.7 months	24-13 males/11 females	Not reported/ Los Angeles	House Ear Institute CARE Center	Oral
James, Rajput, Brinton, & Goswami, 2008	No	Causal-comparative	5.9–10.6	19—11 male/8 female 9 were fitted with a cochlear implant (CI) between 2 and 3.6 yrs; 10 were fitted with a CI between 5 and 7 yrs	Not reported/ England	School and home settings	11 = Oral 8 = Total Communication
Paatsch, Blamey, Sarant, & Bow, 2006	No	Pretest/ posttest, one-group design	5.9–12.2	21—9 male/ 12 female	Not reported/ Australia	Mainstream school with a program for deaf students	Oral

Degree of hearing loss	*Intervention and duration*	*Dependent variable*	*Summary*	*Implications*
			learning. The results also corroborated with previous studies that noted that early implantation is important for language development.	therefore, memory should be assessed.
Mild to moderately severe	No intervention	Peabody Picture Vocabulary Test-III (PPVT-III), 80 trials of 10 repetitions of 8 novel words presented on a touch-screen monitor.	Students viewed a 4-minute animated story read by a female speaker that included eight novel words paired with pictures of uncommon toys, repeated on three different occasions within the story. Hearing children significantly outperformed the children with a hearing loss on the novel-word learning tasks. Deaf and hard of hearing participants also did not perform as well on the PPVT-III as their hearing peers. Novel-word learning scores were highly correlated with scores on the PPVT-III.	The ability to learn novel words rapidly is related to students' current level of vocabulary. Students with larger vocabularies learn words more easily.
Profound	No intervention	Peabody Picture Vocabulary Test-III (PPVT-III)	The children in Group A1 who received their cochlear implants between 1.0-2.5 years of age showed greater rates of vocabulary growth. The earlier the child received a cochlear implant, the better his or her rate of vocabulary growth. There was no significant difference in the rate of vocabulary growth after the implantation age of 4 years.	Early cochlear implantation (before the age of 2.5 years) may lead to a burst of vocabulary growth immediately following implantation. Early cochlear implantation may lead to better speech and vocabulary outcomes over time.
Mild-moderate	No intervention	MacArthur-Bates Communicative Development Inventories (CDI) were completed prior to the administration of the Reynell Developmental Language Scales (RDLS)	The researchers suggest that the CDI is a valid tool for documenting and describing language developmental milestones in children with cochlear implants. It is also a good measurement tool for monitoring and describing the child's strengths and weaknesses.	The CDI may be beneficial for professionals in clinical and school settings who work with children who have cochlear implants. The CDI may reflect natural language and vocabulary development more than formal assessments.
Profound = 19	No intervention	The British Picture Vocabulary Scale (BPVS)	Children who were fitted with a CI at an earlier age performed better on the receptive vocabulary assessment. Several children who were fitted at a later age also made progress in receptive vocabulary over the course of the study.	Children who are fitted with a cochlear implant at an earlier age may perform better on vocabulary tests than children who are fitted at a later age.
Mild=1 Moderate=1 Severe=3 Profound=16	Seventy of 109 words were integrated into a curriculum for a 15-week period. Teachers taught words using oral discussion of word meanings, pictorial representations of the words, words in sentences	109 monosyllabic CVC words (e.g., had, keep, doll, bed).	Students demonstrated significant improvement after vocabulary training.	Intensive daily vocabulary teaching that includes discussion of word meanings, picture representations of words, and constructing sentences that illustrate a word's correct semantic and syntactic use may be effective in vocabulary training.

Table 1 *(continued)*

Source	Control group	Type of study	Age (years–months)	Participants/ gender	Ethnicity (where conducted)	Setting	Communication modality
Pittman, 2008	No	Causal-comparative	8.1–10.7, *M* = 9.3	14—7 female/ 7 male	Not reported	Not reported	Oral
Schorr, Roth, & Fox, 2008	No	Causal-comparative	5.4–14.11	56 39=deaf/19 males/ 20 females 37=normal hearing/19 males/ 18 females	Not reported/ Maryland	University clinic	Oral
Easterbrooks, Lederberg, Miller, Bergeron, & Connor, 2008	No	Pretest-posttest one-group design	2.11–6.11, *M* = 5.2	44/ Not reported	Not reported/Not reported	Self-contained preschool, kindergarten, and first-grade classrooms, public school districts, oral private school, day school for deaf students	Oral, Total Communication, bilingual/Total Communication

recognition of the critical role of vocabulary in educational outcomes, we undertook the present study to identify, collect, and review the research published in peer-reviewed journals related to vocabulary and school-age students who are deaf or hard of hearing. Our findings suggest that in the 41- year period 1967–2008, a total of 41 studies of any type (single-subject, case study, descriptive, causal-comparative, quasi-experimental, experimental) were completed and published. Ten of the 41 published studies included an intervention.

Potential limitations of the present study need to be noted. First, although we attempted to undertake an exhaustive review of the literature, it is possible that pertinent studies were not included because the search terms we used were not sufficient. Second, a study may have been conducted that focused on reading in which vocabulary was a component of the study even though this was not reflected in the title. Third, we did not include dissertation studies, unpublished studies, studies reported in book chapters, or studies published as part of conference

Degree of hearing loss	*Intervention and duration*	*Dependent variable*	*Summary*	*Implications*
	and in discourse, and in school and homework-based activities.			
Profound = 1 Severe = 3 Moderately severe = 4 Moderate = 3 Mild = 3	No intervention	Nonsense words paired with novel pictures	The researcher compared a group of normally hearing students with a group of students with a hearing loss on learning novel words in two conditions—limited and extended bandwidth. Both groups performed better in the extended bandwidth condition (i.e., high-frequency amplification). The students with a hearing loss required approximately twice the number of exposures to learn new words in comparison to the hearing group.	Students with hearing loss have significantly smaller vocabularies than hearing peers and require more exposures in order to learn new words. Speech signals with extended high-frequency amplification (i.e., similar to normal hearing) permitted students to learn words faster. Hearing aids with frequency transposition may improve speech perception and word learning.
Not reported	No intervention	The Peabody Picture Vocabulary Test-III and the Expressive Vocabulary Test assessed receptive and expressive vocabulary skills.	The researchers compared the vocabulary skills of children with cochlear implants (CI) and children with normal hearing (NH). Thirty-six percent of the children with CI and 92% of the children with NH had age-appropriate skills.	Children with cochlear implants may demonstrate lower scores on vocabulary measures than children with normal hearing.
Range = 58–110 dB, *M* = 94.3 dB	Intervention was not described.	Woodcock-Johnson Achievement Test-III Picture Vocabulary	The researchers assessed the students in the fall and again in the spring on a variety of measures (e.g., Speech Perception, Phonological Awareness, Alphabetics, Vocabulary, and Early Reading Skills). Scores significantly increased across the year on all tests except vocabulary and rhyming. A large portion of students scored below the normal range on the vocabulary test. Scores on vocabulary and phonological awareness predicted performance on two measures of early literacy: letter-word identification and passage comprehension.	The authors note that typical hearing children acquire a large portion of their vocabulary incidentally, which often is not the case for children who are deaf or hard of hearing. As a result, most children who are deaf or hard of hearing require explicit instruction to improve their vocabulary performance.

proceedings. Fourth, we did not examine the research undertaken with children who are deaf or hard of hearing ages birth–3 years, which is a critical time period for vocabulary development. A study summarizing the research with that age group would be a positive supplement to this work. Fifth, reading, summarizing, determining implications for each study, and developing Table 1 was an interpretive process. It is possible that other individuals using similar procedures may have reported each study as well as summarized the corpus of studies differently. Each of these factors should be taken into consideration in any effort to generalize the results presented in this article.

Review of the results supported assertions made previously about the shortage of research to establish evidence-based practices in the field of deaf education (e.g., Luckner, 2006; Paul, 2009; Schirmer, & McGough, 2005). Only 24% of the studies we reviewed were undertaken to examine whether a specific intervention would improve the vocabulary learning of students who are deaf or hard of hear-

ing. This is equivalent to approximately one study every 2 years. Also, examination of the intervention studies suggested that there has been a lack of systematic inquiry. Specifically, we did not see any studies with positive interventions being replicated with either different samples, in other settings, or by different researchers. Furthermore, the extent of evidence for the interventions that demonstrated positive outcomes would be considered small using the standards established by the U.S. Department of Education Institute of Education Sciences (2008) or as a "tentative evidence-based practice" (e.g., Thompson, Diamond, McWilliam, P. Snyder, & S. W. Snyder, 2005). Finally, no studies adhered to the recommendations of the American Psychological Association (2001) and reported effect size or strength of relationships, which would have indicated the magnitude of the effect or relationship. Rather, all of the studies simply reported statistical significance. Given the importance of vocabulary for interacting, reading, and thinking, replication and increased attention to this topic needs to occur in the future. We address suggestions for potential research topics later in the present article.

Thirteen studies either directly or indirectly had implications for the quantity and quality of interactions with others. Whether the interactions were enhanced by the use of cochlear implants, Total Communication, hearing aids with enhanced bandwidth, or tactile stimulation, the essential role of conversation in the learning of vocabulary is noteworthy (Armbruster et al., 2003). Conversations provide an avenue for words to be repeated multiple times in context and for new and interesting words to be presented, a process that is difficult to replicate through the use of a structured language program.

Multiple studies found a relationship between vocabulary knowledge and reading comprehension. As noted previously, the existence of this relationship is a time-honored assumption and a consistent research finding in the general field of literacy (e.g., Becker, 1977; Cunningham & Stanovich, 1998: Snow, 2002). Additionally, several studies reported that hearing students had significantly larger vocabularies than the comparative sample of students who were deaf or hard of hearing. This disparity in word knowledge has been reported in the literature for decades (e.g., Moores, 1978).

As we have already noted, two intervention studies reported positive results from using computers for vocabulary instruction. The National Reading Panel (2000) noted similarly promising findings in the area of vocabulary and computer-based instruction with hearing students. Bosseler and Massaro (2003) also found positive results with children with autism, as did Dubois and Vial, (2000) with students learning a second language, and G. Johnson, Gersten, and Carnine (1987) with high school students with a learning disability.

Advantages of using computer-controlled applications for vocabulary training include (a) less direct teacher time than teacher-led instruction, (b) the amount of automated practice it makes possible, (c) the potential to individualize instruction, (d) the provision of immediate feedback, (e) imbedded instructional design features such as systematic review and instructional scaffolding, and (f) multiple sources of information such as images, text, and sound that facilitate learning and improve retention of the target vocabulary (Bosseler & Massaro, 2003; Carnine, Silbert, Kame'enui, & Tarver, 2004). Many commercial programs are available that allow professionals to create crossword puzzles, produce word games, and make semantic maps. Vocabulary University (www.syndicate.com) is a website with grade-level puzzles, word games, and word activities. Word Play (http://www.fun-with-words.com/word.htm) is a website that links to many other sites featuring fun activities with words. Examples of commercial computer programs with a vocabulary focus are Words Rock, by EdAlive (kindergarten to ninth grade), and Word Adventure 2K1, by WordSmart (kindergarten to second grade).

The MacArthur-Bates Communicative Development Inventories (CDI) was reported to be a valid measure to assess vocabulary skills in several studies. This is valuable information for home interventionists, early intervention professionals, and researchers who want to conduct assessments of young children with a hearing loss. In addition, family members and professionals can use the word frequency program and the accompanying age-range information available on the authors' web site (http://www.sci.sdsu.edu/cdi/) to identify specific gestures, words, and sentences to prioritize as language targets. This information is available in both English and Spanish.

As Owens (2009) has explained, "At its core, word meaning consists of concepts or knowledge of the world. Words do not name things, but rather refer to these concepts. These conceptual complexes are formed from many experiences with the actual referents or with conversational or literary use of the words" (p. 299). Also, people link words in their minds semantically in several ways, such as words that frequently go together (e.g., *bread* and *butter*), categories (e.g., sports, transportation), whole and parts (e.g., computer—keyboard, monitor, mouse), synonyms, and antonyms (D. D. Johnson, 2001). Consequently, in two studies the re-

searchers recommended teaching semantic organization and semantic concepts.

In content areas such as mathematics, science, and social studies, students are required to learn new words that represent unknown concepts (e.g., *proportionality*, *photosynthesis*, *monarchy*). As D. D. Johnson (2001) explained, "To learn any subject matter, one must learn relevant concepts, facts, skills, and processes. These are almost always expressed as or in words. Thus, learning vocabulary is essential for learning any subject" (pp. 96–97). Educators can present definitions and explanations of essential concepts. In addition, in an effort to relate new vocabulary or concepts to old knowledge, professionals can use semantic maps and graphic organizers to show how words and ideas are related to each other (Luckner, Bowen, & Carter, 2001). Three advantages of semantic maps and graphic organizers are that (a) they provide a visual display between concepts and the key vocabulary, (b) the development of the visual often provides an avenue for discussion and active thinking, and (c) exposure to many conceptually related words often occurs (Schirmer, 2000). Semantic feature analysis, the Frayer model, and semantic gradients are additional techniques educators can use to show relationships among vocabulary or concepts (Blachowicz & Fisher, 2010).

A challenge in designing vocabulary instruction for students who are deaf or hard of hearing involves the selection of target words for instruction. The researchers in two studies suggested that students be taught high- frequency words (e.g., *the*, *of*, *and*, *to*, *you*, *that*, *this*). High-frequency words, often referred to as *sight words*, make up about 65% of all written material (Harp & Brewer, 2005). Many of these words carry minimal meaning themselves. Yet they do affect readers' ability to comprehend text. Fry (1980) developed a list of the 300 most common words used in print. Carnine and colleagues (2004) devised a similar list of 400 words. Professionals can use a variety of activities and procedures, such as word banks, word walls, and timed sight-reading word lists to make sure students are able to instantly recognize these words. Once students can read high-frequency words in isolation, they should practice reading them in text.

In addition to directly teaching sight words, professionals will want to directly teach specific word meanings. In two studies, researchers recommended the introduction of key words using rich and explicit examples. At the beginning of a unit of study or before students read a story or a section of a textbook, it is beneficial to teach students specific words that are central to the material being learned. If students are acquainted with the vocabulary word or concept being learned, then providing a synonym or definition, followed by a couple of examples and nonexamples, may be sufficient. If students are learning a new word that represents an unknown concept (e.g., *evaporation*), then providing a definition, examples, nonexamples, discussion, graphic organizers, and daily review over the course of several days would be appropriate (Carnine et al., 2004). When less time is available to explicitly teach the meaning of a word, educators will want to provide definitions that adhere to the format that includes a class and then a distinction when possible (e.g., "A dermatologist is a doctor who works with the skin and its diseases").

Intensive vocabulary instruction was the recommendation of the authors of two studies. Gaps in experiences, concept development, and vocabulary need to be addressed by providing students who are deaf or hard of hearing multiple in-context exposures to words across time. Research with hearing students suggests that they require between 12 (McKeown, Beck, Omanson, & Pople, 1985) and 40 (Reutzel & Cooter, 2004) encounters with a word before they know it well enough to improve their comprehension and integrate it into their existing knowledge base. Being read to and reading independently can significantly improve an individual's vocabulary growth. Yet because many students with a hearing loss struggle with reading, they often choose not to read on their own (Strassman, 1992). As a result, they continue to perpetuate a restrictive cycle in which limited reading leads to inadequate vocabulary growth, which in turn leads to insufficient reading (de Villiers & Pomerantz, 1992). This sequence of impoverished vocabulary growth was summarized by Flesch and Lass (1996), who stated, "You can't build a vocabulary without reading. You can't make friends if you never meet anybody, but stay home by yourself all the time. In the same way, you can't build up vocabulary if you never meet any new words" (p. 105).

Lack of vocabulary also hinders students' ability to learn words independent of context. Consequently, word-learning skills should be explicitly taught. Word-learning strategies include knowing how to use word parts as well as using context clues to figure out unknown words. *Within-word analysis* refers to the process of analyzing words into morphemes, the smallest units of meaning in a word. Morphemic analysis is a useful strategy because most English words were created through the use of morphological rules (e.g., adding prefixes and suffixes to root words; compounding,

contracting, abbreviating), and as a result it has been estimated that almost 60% of words contain clues to their meaning (Nagy & Anderson, 1984). When introducing morphemes, educators will want to begin with the most frequently used prefixes and suffixes. White, Sowell, and Yanighara (1989) identified 11 prefixes (*un-*, *re-*, *in-*, *dis-*, *en-/em-*, *non-*, *in-/im-*, *over-*, *mis-*, *sub-*, *pre-*) and six suffixes (*-s/-es*, *-ed*, *-ing*, *-ly*, *-er/-or*, *-ion/-tion*) that appear in 80% of all prefixed and suffixed words.

"Context clues are hints about the meaning of an unknown word that are provided in the words, phrases, and sentences that surround the word" (Armbruster et al., 2003, p. 40). Blachowicz and Fisher (2010) have suggested an instructional sequence for learning how to use context clues:

1. Look—Before, at, and after the word.
2. Reason—Connect what you know with what the author has written.
3. Predict a possible meaning.
4. Resolve or redo—Decide if you know enough, should try again, or consult an expert or a reference (e.g., dictionary or thesaurus). (p. 33)

Modeling, discussion, group practice, and independent practice should be included in narrative as well as expository vocabulary instruction of morphemic analysis and context clues strategy instruction.

Another factor that hinders development of reading comprehension abilities in students who are deaf or hard of hearing and perpetuates the fourth-grade plateau that many of these students experience is the increase in decontextualized language and the requirement to infer meaning from what is being read (Mayer, 2007; Paul, 2009). Consequently, in two studies the researchers suggested instruction in inferential strategies to assist vocabulary development. To teach inferential skills, educators will want to use the procedures discussed above—context clues and morphological analysis—as well as teach students to predict possible word meanings based on their background knowledge of the concept.

As we have previously noted, additional research needs to be undertaken to enable a better understanding of the specific types of interactions and teaching approaches that help students who are deaf or hard of hearing develop age-appropriate vocabulary knowledge. Replication of the intervention studies summarized in the present article would be a valuable contribution to the field. Additionally, intervention studies should be designed to determine if the recommendations based on reviewed descriptive, correlational, and causal-comparative studies improve students' vocabulary development.

Vocabulary programs that have been effective with other student populations should also be researched with students who are deaf or hard of hearing. For example, *Language for Learning* (grades pre-K–2; Engelman & Osborn, 2008) *and Language for Thinking* (grades 1–3; Engelman & Osborn, 2002) are explicit instructional programs with scripted lessons to teach language skills to young children, as well as the basic language of instruction, concepts, and reasoning. *Vocabulary Improvement Program for English Language Learners and their Classmates* (Carlo et al., 2004) is a program for students in grades 4–6 that focuses on academic vocabulary and strategies for learning unfamiliar words. Activities are designed to engage students in cooperative work, give them multiple encounters with targeted words, and build word consciousness in a rich language atmosphere.

Furthermore, a similar summary of vocabulary research with children who are deaf or hard of hearing from ages birth to 3 years should be conducted. Also, given the positive results that have been attributed to early intervention services (e.g., Moeller, 2000; Yoshinaga-Itano, 2003), it may be beneficial to examine the impact on vocabulary development of increasing the duration or intensity, or altering the delivery method, of early intervention services. For example, home interventionists generally visit a family once a week for an hour or two (Brown & Yoshinaga-Itano, 1994). What would the impact on the child's vocabulary development be if visits occurred three times a week for 1 hour each? What if they took place once a week in person for 2 hours and once a week for 1 hour via videoconferencing? What if once a year for a week the family stayed in a "demonstration house" with professionals who provided intensive instruction, modeling, and feedback on communication techniques? What if synchronous or asynchronous group classes for families of similar-age children were offered on the Internet? Research questions that address alternative models of service delivery, such as these, may be valuable to explore.

Conclusion

"Words are the starting point. Without words, children can't talk about people, places, or things, about actions, relations, or states" (Clark, 1993, p. ix). Depth and breadth of vocabulary knowledge affects individuals' ability to communicate, to understand what they read, to succeed academically as well as in the world of work. The importance of vocabulary for success in these areas was highlighted in two re-

cent U.S Department of Education reports, one on students in the primary grades (Gersten et al., 2009) and one on adolescents (Kamil et al., 2008). The authors emphasized that children and youth benefit from repeated exposure to vocabulary. Accordingly, they recommended that educators

1. dedicate a portion of regular classroom lessons to explicit vocabulary instruction
2. provide repeated exposure to new words in multiple contexts, and allow sufficient practice sessions in vocabulary instruction
3. give sufficient opportunities to use new vocabulary in a variety of contexts through activities such as discussion, writing, and extended reading
4. provide students with strategies to make them independent vocabulary learners
5. integrate explicit vocabulary instruction into content-area curricula such as science and social studies in order to enhance students' ability to acquire textbook vocabulary

Students who are deaf or hard of hearing lag behind their hearing peers in the critical area of vocabulary knowledge. A shortage of research to guide educators currently exists. We hope the synthesis of existent research as well as the summary of suggestions provided in the present article will help increase the quantity and quality of vocabulary instruction provided to students, as well as guide and stimulate additional investigations into how best to improve the vocabulary skills of students who are deaf or hard of hearing.

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Appendix A

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